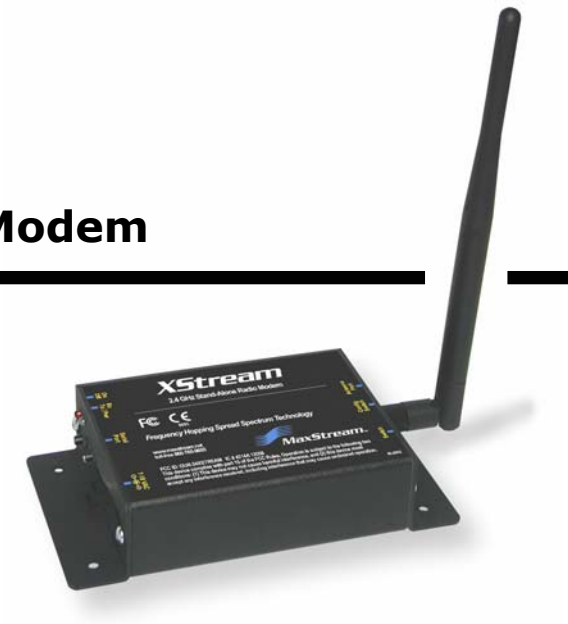
XStream-PKG-E™ Ethernet RF Modem

XStream Ethernet RF Modem

Operation

RF Modem Configuration

Appendices



Product Manual v4.2A

XStream RF Modem Part Numbers:

X09-001PK…-E…
X09-009PK…-E…
X09-019PK…-E…
X24-009PK…-E…
X24-019PK…-E…
XH9-009PK…-E…

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Contents

XStream Ethernet RF Modem 4

Features 4
Worldwide Acceptance 4
XStream-PKG-E Interface 5
Front and Back Views 5
XStream-PKG-E Ethernet RF Modem Specifications 6

RF Operation 7

Data Radio System Components 7
System Description 7
Communications 8
Com Port Communications 8
Setup Com Port & IP Address 9
Assign Static IP Address 10
Change Com Port Number 10
Testing Communications 11

RF Modem Configuration 13

AT Command Mode 13
Configuration 15
XStream Commands (Short View) 16

Appendix A: Agency Certifications 17

FCC Compliance 17
OEM Labeling Requirements 17
FCC Notices 18
9XStream-PKG-E (900 MHz) Approved Antenna List 19
24XStream-PKG-E (2.4 GHz) Approved Antenna List 20
European Compliance (2.4 GHz only) 21
OEM Labeling Requirements 21
Restrictions 21
IC (Industry Canada) Certification 22

Appendix B: Additional Information 23

1-Year Warranty 23
XStream-PKG RF Modem Part Numbers 23
Ethernet Background Information 24
Contact MaxStream 24

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XStream Ethernet RF Modem

XStream-PKG-E Ethernet RF Modems extend system performance and flexibility by adding serial connectivity to Ethernet networks.

MaxStream RF Modems handle the complexities inherent to RF communications (modulation, demodulation, frequency synthesizers, amplifiers, filters, FCC approvals, etc.), so OEMs and integrators can focus resources beyond the wireless portion of the data system.

Features

Long Range at a Low Cost

9XStream (900 MHz) Range:

- Indoor/Urban: **up to 1500'** (450 m)
- Outdoor line-of-sight: **up to 7 miles** (11 km) w/ dipole antenna
- Outdoor line-of-sight: **up to 20 miles** (32 km) w/ high gain antenna

24XStream (2.4 GHz) Range:

- Indoor/Urban: **up to 600'** (180 m)
- Outdoor line-of-sight: **up to 3 miles** (5 km) w/ dipole antenna
- Outdoor line-of-sight: **up to 10 miles** (16 km) w/ high gain antenna

Receiver sensitivity: **-110 dBm** (900 MHz), **–105 dBm** (2.4 GHz) [-93 dBm is industry average]

Advanced Networking & Security

True Peer-to-Peer (no "master" required), Point-to-Point, Point-to-Multipoint, Multidrop

Retries and Acknowledgements

7 hopping channels, each with over 65,000 network addresses available

Easy-to-Use

FCC & international agency approved

No configuration required

Advanced configurations using standard AT Commands

Transparent Operation (replaces serial wires)

Portable (small form factor & low power)

Software-selectable serial interfacing

MODBUS Support

Support for multiple data formats (parity, start and stop bits, etc.)

XII™ Interference Immunity

Power-saving Sleep Modes

FHSS (Frequency Hopping Spread Spectrum)

Worldwide Acceptance

FCC Certified (USA) [Go to Appendix A for FCC Requirements]
Systems that contain XStream RF Modems can inherit MaxStream's FCC Certification

ISM (Industrial, Scientific & Medical) frequency band

Manufactured under **ISO 9001:2000 registered standards**

9XStream-PKG-E (900 MHz) RF Modems approved for use in **US**, **Canada**, **Australia**, **Israel** (and more). 24XStream-PKG-E (2.4 GHz) adds **EU** (Europe) and other approvals.

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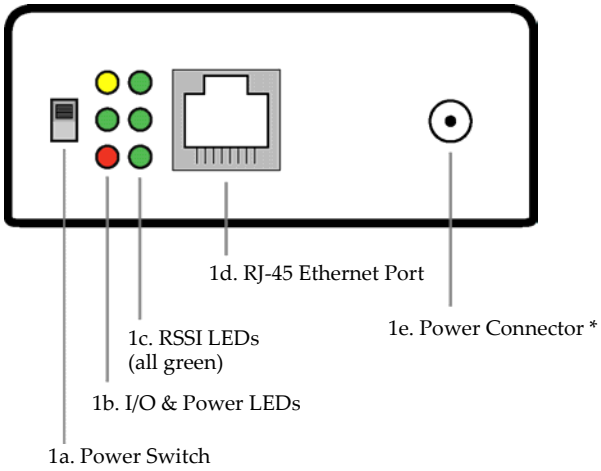
XStream-PKG-E Interface

Front and Back Views

Figure 1. Front View



* The Ethernet RF Modem does not support Power-over-Ethernet (PoE). The device cannot be powered directly from a PoE port on a compatible hub.

However, it may be useful to send power on the unused wires of the CAT-5 cable in situation where the radio will be mounted in a location that optimizes radio coverage but may not have a power outlet nearby. There are several third part devices available that can inject the power onto the cable and then remove it at the remote side.

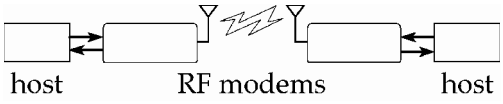
1a. Power Switch

Move Power Switch to the ON (up) position to power the XStream PKG-E Ethernet RF Modem.

1b. I/O & Power LEDs

LEDs indicate modem activity as follows:

Yellow (top LED) = Serial Data Out (to host)
Green (middle) = Serial Data In (from host)
Red (bottom) = Power/TX Indicator (Red light is on when powered, pulses off briefly during RF transmission)



1c. RSSI LEDs

RSSI LEDs indicate the amount of fade margin present in an active wireless link. Fade margin is the difference between the incoming signal strength and the modem's receiver sensitivity.

3 LEDs ON = Very Strong Signal (> 30 dB fade margin)
2 LEDs ON = Strong Signal (> 20 dB fade margin)
1 LED ON = Moderate Signal (> 10 dB fade margin)
0 LED ON = Weak Signal (< 10 dB fade margin)

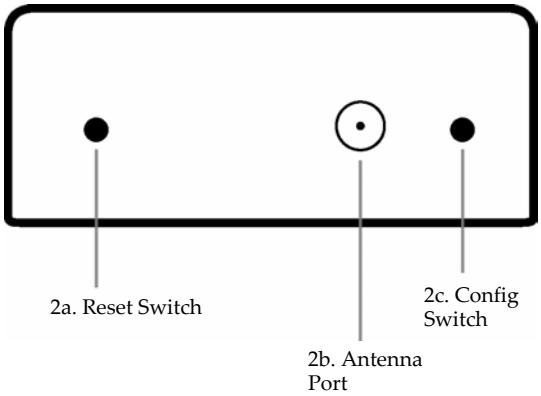
1d. RJ-45 Ethernet Port

Standard Female RJ-45 connector is used to connect unshielded twisted-pair CAT5 cabling.

1e. Power Connector *

7-28 VDC Power Connector.

Figure 2. Back View



2a. Reset Switch

Reset Switch forces the RF Modem to reset (or re-boot).

2b. Antenna Port

Antenna Port is a 50 Ω RF signal connector for connecting to an external antenna. Connector type is Reverse Polarity (RPSMA) female. The RPSMA has threads on the outside of a barrel and a male center conductor.

2c. Config (Configuration) Switch

The Config Switch provides an alternate way to enter AT Command Mode.

To enter Command Mode at the Modem's default baud rate: Simultaneously press the Reset [2a] and Config switches; release the Reset Switch; then after 1 sec., release the Config Switch. The RF Modem then enters AT Command Mode at the modem's default baud rate.

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XStream-PKG-E Ethernet RF Modem Specifications

Table 1. XStream-PKG-E Ethernet RF Modem (900 MHz & 2.4 GHz) Specifications

Specification	9XStream-PKG-E (900 MHz)		24XStream-PKG-E (2.4 GHz)	
Performance				
Indoor/Urban Range	Up to 1500' (450 m)		Up to 600' (180 m)	
Outdoor LOS Range	Up to 7 miles (11 km) w/ dipole antenna Up to 20 miles (32 km) w/ high-gain antenna		Up to 3 miles (5 km) w/ dipole antenna Up to 10 miles (16 km) w/ high-gain antenna	
Serial Data Throughput	**9600 bps**	**19.2 kbps**	**9600 bps**	**19.2 kbps**
RF Baud Rate	10,000 bps	20,000 bps	10,000 bps	20,000 bps
Transmit Power Output	100 mW (20 dBm)	100 mW (20 dBm)	50 mW (17 dBm)	50 mW (17 dBm)
Receiver Sensitivity	-110 dBm	-107 dBm	-105 dBm	-102 dBm
General				
Frequency	902-928 MHz		2.4000-2.4835 GHz	
Spread Spectrum	Frequency Hopping, Wide band FM modulator			
Network Topology	Peer-to-Peer, Point-to-Point, Point-to-Multipoint, Multidrop			
Supported Network Protocols	ARP, UDP, TCP, ICMP, Telnet, TFTP, AutoIP, DHCP, HTTP and SNMP (read-only)			
Channel Capacity	7 hop sequences share 25 frequencies			
Serial Data Interface	RJ-45 Female Ethernet Connection			
I/O Data Rate	Software selectable 1200 - 57600 bps			
Power Requirements				
Supply Voltage	7-28 VDC			
Transmit (TX) Current*	400 mA, 9V		400 mA, 9V	
Receive (RX) Current*	250 mA, 9V		275 mA, 9V	
Power Down Current*	230 mA, 9V		230 mA, 9V	
Physical Properties				
Enclosure	Extruded aluminum, black anodized			
Enclosure Size	2.750" x 5.500" x 1.124 (7.90cm x 13.90cm x 3.80cm)			
Operating Temperature	0 to 70º C (commercial), -40 to 85º C (industrial)			
Antenna				
Type	½ wave dipole whip, 6.75" (17.1 cm), 2.1 dBi Gain			
Connector	Reverse-polarity SMA (RPSMA)			
Impedance	50 ohms unbalanced			
Certifications				
FCC Part 15.247	OUR9XSTREAM		OUR-24XSTREAM	
Industry Canada (IC)	4214A-9XSTREAM		4214A 12008	
Europe	N/A		ETSI, CE	

* Divide by 2 for 18V supply (Constant wattage from 7 to 28 V).

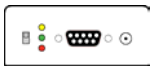
RF Operation

Data Radio System Components

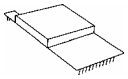
XStream Radio Modems are designed to provide long range wireless links between devices in a data system. The PKG-E Ethernet RF Modem connects serial modems to Ethernet networks.

The following devices will be used to describe a data system that includes the XStream-PKG-E Ethernet RF Modem:

XStream-PKG-E Ethernet RF Modem ("PKG-E"): The Ethernet RF Modem is an Ethernet-connected serial modem used for communication with other MaxStream serial modems. The Ethernet RF Modem is not a wireless Ethernet Bridge intended for Ethernet connectivity on both the remote and base sides of a wireless link.



XStream-PKG-R RS-232/485 RF Modem ("PKG-R"): The RS-232/485 RF Modem is a serial modem that can be identified by its DB-9 serial port and 6-switch DIP Switch.

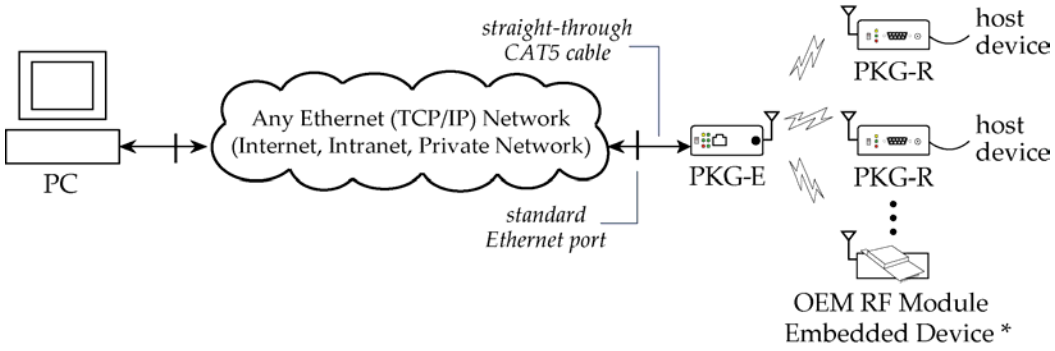


XStream OEM RF Module ("OEM RF Module"): The OEM RF Module is mounted inside all XStream-PKG RF Modems and may be integrated into OEM-designed products to transmit and receive data over-the-air.

System Description

The PKG-E Ethernet RF Modem can be used as an access point in a network of MaxStream RS-232/RS-485 RF Modems (or other OEM RF Module Embedded Devices). XStream RF Modems support point-to-point, peer-to-peer, point-to-multipoint and multidrop network topologies. Below is an example of a typical point-to-multipoint application:

Figure 3. XStream-PKG-E Ethernet RF Modem in a Point-to-Multipoint Data Radio System



* The "OEM RF Module Embedded Device" represents any device that contains in it an XStream OEM RF Module. This includes other XStream RF Modems (Ethernet, USB, RS-232/485 or Telephone) and any other devices that contain in them an XStream OEM RF Module.

Communications

The Ethernet-connected serial modem supports several connection options:

- Com Port Redirector Software enables legacy serial applications to communicate with the Ethernet RF Modem by forwarding serial data over Ethernet.
- "Telnet" communicates directly to the Ethernet RF Modem using port 14001. Refer to the "Telnet Loopback Test" section on page 11 for an example that by-passes the com port.

Com Port Communications

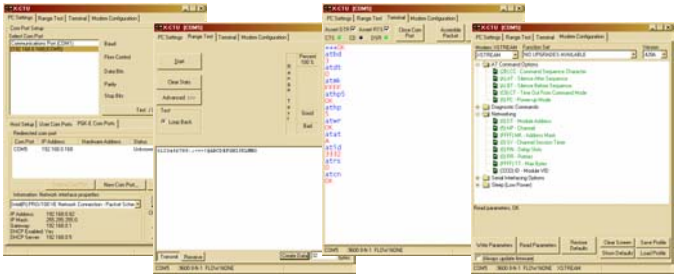
The X-CTU and Com Port Redirector software facilitate communications through a PC's com port. Follow the instructions below to setup a com port for configuring and testing RF modems.

Installation #1: X-CTU Software (version 4.8.0 or higher*)

Use the X-CTU software to configure the Ethernet RF Modem and PC com port. The software provides is divided into four tabs:

- **PC Settings** tab - Setup PC serial com ports to interface with RF modem
- **Range Test** tab – Test RF modem's range under varying environments
- **Terminal** tab – Test serial communications and set/read RF Modem parameters
- **Modem Configuration** tab – Set/read RF Modem parameters

Figure 4. Tabs of the X-CTU Software



* To verify X-CTU version number, click on the icon located in the top-left corner of the X-CTU user interface and then select the "About X-CTU…" menu item.

To Install the X-CTU Software:

Double-click the "setup_X-CTU.exe" file then follow prompts of the installation screens. This file is located in the "software" folder of the MaxStream CD and under the 'Downloads' section of the following web page: www.maxstream.net/helpdesk/.

Installation #2: Ethernet Com Port Redirector

MaxStream provides com port redirection software that creates a com port in the operating system that will forward serial data to the IP address of the Ethernet-connected RF modem. The Ethernet RF Modem can then be accessed by any com port enabled application.

The Ethernet Com Port Redirector must be installed separately to enable the "Ethernet Com Ports" sub-tab of the X-CTU "PC Settings" tab. If this software is not installed, the features under the "Ethernet Com Ports" section are grayed and cannot be used.

The "Ethernet Com Ports" sub-tab enables user to perform functions such as the following:

- Discover Ethernet RF Modems on a network
- Setup serial com ports for XStream-PKG-E Ethernet RF Modems
- Identify, assign and modify Ethernet RF Modem IP addresses

To Install the Ethernet Com Port Redirector:

1. Double-click the "setup_ComPortRedirector.exe" file then follow prompts of the installation screens. This file is located in the "software" folder of the MaxStream CD.
2. Re-boot the PC to complete installation.

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Setup Com Port & IP Address

The XStream-PKG-E Ethernet RF Modem supports DHCP (Dynamic Host Configuration Protocol) and Auto IP protocols. Both protocols automatically assign IP addresses to nodes of a network.

Ethernet RF Modem Discovery

The X-CTU Software provides an easy-to-use interface that searches a local network and then displays Ethernet RF Modems found.

Discover Ethernet RF Modem, Map Com Port & Assign IP Address:

1. Install both the X-CTU and the Ethernet Com Port Redirector software [See "Com Port Communications" section on previous page]. Re-boot the PC if necessary.
2. Launch the X-CTU Software and select the "PC Settings" tab; then select the "Ethernet Com Ports" sub-tab. [Figure 5]
   → After the Com Port Redirector is installed (& PC is re-booted), a "Setup Com Port" dialog box will appear only the first time the "Ethernet Com Ports" sub-tab is selected.
3. Select the "OK" button.
   → All discovered Ethernet RF Modems will be displayed in a new "Assign IP Address" dialog box. [Figure 6]
4. Highlight one of the discovered Ethernet RF Modems (Modem IP and Hardware Addresses are listed in the "… discovered Ethernet Modem" section) [Figure 6]. If an Ethernet Modem is not discovered, enter the IP address manually in the "Enter IP Address…" box.
5. Select the "OK" button.
   → Newly assigned Ethernet Modem is listed under the "Ethernet Com Ports" sub-tab and the first available com port is assigned to it.
6. **Select the "Apply" button.** Button is located in the "Changes" section of the "Ethernet Com Ports" sub-tab. [Figure 5] Even though the Ethernet RF Modem appears in the "Ethernet Com Port" list, the new com port cannot be used until changes are applied and the PC is re-booted.
7. Re-boot the PC; then re-launch the X-CTU Software. The com port can now be used to communicate with the RF Modem. Refer to the "Testing Wireless Links" and "Configuration Methods" sections for more information about com port communications.

Figure 5. Ethernet Com Ports sub-tab
(Ethernet Com Ports sub-tab is enabled by installing the Ethernet Com Port Redirector Software.)

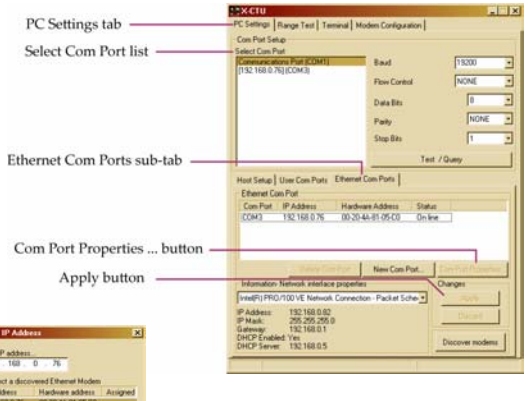


Figure 6. Assign IP Address dialog box

If the Ethernet RF Modem is left in DHCP mode, it may become necessary to reconfigure a mapped com port any time an IP address is re-assigned by the DHCP server. Dynamic addressing is supported, but setting a static IP address can simplify the application.

Assign Static IP Address

To assign a static IP address to the Ethernet RF Modem, follow the steps outlined below. A static IP address may be necessary when:

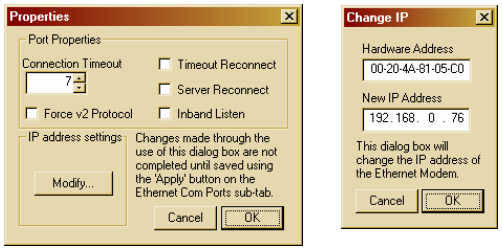
- The Ethernet RF Modem and the host PC are on different subnets
- The Ethernet RF Modem IP address might be changed by a DHCP server

Configure a static IP address on a local network:

1. Install both the X-CTU Software and the Ethernet Com Port Redirector software [See "Com Port Communications" section]. Re-boot the PC if it has not been re-booted since the installation of the Ethernet Com Port Redirector.
2. Launch the X-CTU Software and select the "PC Settings" tab; then select the "Ethernet Com Ports" sub-tab [Figure 5].
   → After the Ethernet Com Port Redirector is installed (and PC is re-booted), a "Setup Com Port" dialog box will appear the first time the "Ethernet Com Ports" sub-tab is selected. The following steps are written under the assumption the sub-tab has already been selected at least one time.
3. Select the "Discover modems" button to display which modems are on-line and which are not; then click the "OK" button of the "Discover Ethernet Modems" dialog box.
4. Click-on and highlight an Ethernet RF Modem from the "Ethernet Com Ports" list.
5. Select the "Com Port Properties" button [Figure 5].
6. Select the "Modify" button of the "Properties" dialog box [Figure 7].
7. Type a new IP address; then select the "OK" button [Figure 7].
8. Select the "OK" button of the "Properties" dialog box.
9. Select the "Apply" button that is under the "Changes" section of the "Ethernet Com Ports" sub-tab.

   → The XStream-PKG-E Ethernet RF Modem re-boots and the new IP Address is saved.

Figure 7. Properties & Change IP dialog boxes



Change Com Port Number

During Com Port Redirector setup, one com port is automatically assigned. Additional com ports are user-assigned. Use the following steps to manually change a com port number:

Change Ethernet RF Modem's Com Port Number:

1. Once the Ethernet RF Modem is recognized and displayed under the "Ethernet Com Ports" sub-tab, select the "New Com Port" button. Follow the steps outlined in the "Ethernet RF Modem Discovery" section
2. Type-in the IP Address of the Ethernet Modem and highlight a com port number; then select the "OK" button
3. Select the "Apply" button; then re-boot the PC if prompted to do so.
4. Go to the "Ethernet Com Ports" sub-tab of the X-CTU Software's "PC Settings" tab.
5. Highlight the old com port entry, select the "Delete Com Port" button, then select the "Apply" button.

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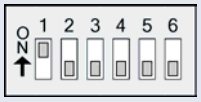
Testing Communications

When testing a wireless link, MaxStream suggests creating the link using the following components:

- XStream-PKG-E Ethernet RF Modem (connected to a local network)
- XStream-PKG-R RS-232/485 RF Modem (w/ loopback adapter)
- PC (connected to a local network)
- Peripherals (Loopback adapter, CAT5 UTP cable, power supplies and RPSMA antennas)

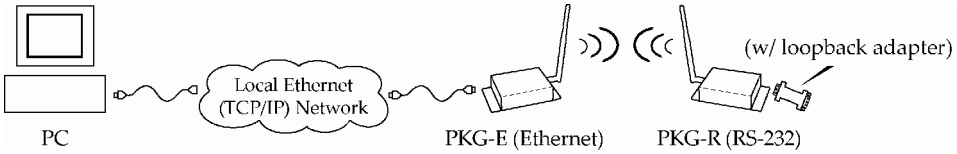
Hardware Setup for Loopback Test:

1. Connect the XStream-PKG-E (Ethernet) RF Modem and a PC to active Ethernet ports of the same local network using CAT5 cables (included w/ PKG-EA accessories package).
2. Attach the serial loopback adapter to the DB-9 serial connector of the XStream-PKG-R (RS-232) RF Modem. The serial loopback adapter configures the PKG-R RF Modem to function as a repeater by looping serial data back into the modem for retransmission.
3. Configure the PKG-R (RS-232) RF Modem for RS-232 operation using the built-in DIP Switch. Dip Switch 1 should be ON (up) and the remaining switches should be OFF (down).



4. Attach RPSMA antennas to both RF Modems.
5. Power both RF Modems with power supplies (included w/ accessories package).

Figure 8. Hardware Setup for Testing a Wireless Link



X-CTU Loopback Test (recommended)

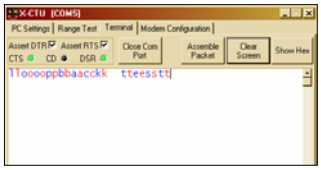
Test a Wireless Link (X-CTU Method)**:**

1. Follow steps in the "XStream-PKG-E Ethernet RF Modem Discovery" section [page 8].
2. Setup hardware as shown in the "Hardware Setup" steps above [Figure 8].
3. Select the "PC Settings" tab of the X-CTU Software; then highlight the Com Port that is forwarded to the PKG-E (Ethernet) RF Modem.
   → Make sure PC com port settings (Baud rate, Parity, etc.) on the "PC Settings" tab match those of the Ethernet RF Modem.
4. Select the "Terminal" tab of the X-CTU Software.
5. Begin typing characters into the terminal window.

   → Characters typed in the terminal should be echoed back to the screen [Figure 9]. Sent characters appear in blue and received characters in red. With each character typed, the 'Data Out' and 'Data In' LEDs should flash briefly on each of the RF Modems.

   → To double-check the Wireless link, turn off the power going to the remote PKG-R (RS-232) RF Modem and leave the PKG-E Modem turned on. Type characters into the Terminal Window and note that characters are not echoed back.

Figure 9. Terminal Tab of MaxStream's X-CTU Software



Telnet Loopback Test

MaxStream Wireless links can be tested by connecting to the specific IP address and port number.

Test a Wireless Link (Telnet Connection)**:**

1. Follow steps in the "XStream-PKG-E Ethernet RF Modem Discovery" section [page 8].
2. Setup hardware as shown in the 'Hardware Setup for Loopback Test' section of previous page [Figure 8].
3. If using Windows: Select (Start → Run); then type "cmd" (without quotation marks) in the text box of the "Run" dialog box. Then select the "OK" button.

   If using Linux or UNIX: Run a command shell.

   If using Mac OS X: Run (Applications → Utilities → Terminal).
4. [Remaining steps are for Windows users]
   At the command prompt, type:
   ```
   telnet xxx.xxx.xxx.xxx 14001 <CR>
   ```
   ("xxx.xxx.xxx.xxx" is the IP address of the Ethernet RF Modem, "14001" is the port number and "<CR>" stands for carriage return.) [Figure 10]
5. Begin typing characters into the Telnet session window [Figure 11].
   → Characters typed should be echoed back to the screen. With each character typed, the "Data Out" and "Data In" LEDs should flash briefly on each of the PKG RF Modems. The Wireless link can be double-checked by turning off the XStream-PKG-R RS-232/485 RF Modem (leaving the PKG-E Ethernet RF Modem on) and sending characters. When the PKG-R is turned off, characters should not be echoed back.

Figure 10. Telnet Interface (connect to PKG-E having an IP address of 192.168.0.168)

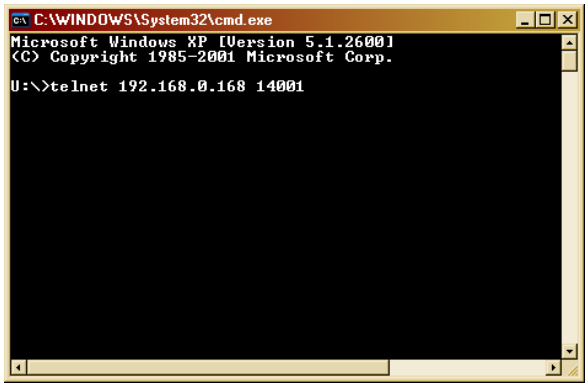


Figure 11. Telnet Interface (Sent & Echoed back characters)

RF Modem Configuration

Out-of-box, the XStream-PKG-E Ethernet RF Modem comes configured to provide an immediate wireless link between devices in a data system. The default configuration supports a wide range of RF communications. The RF modem is configurable to support specific system requirements using standard AT Commands.

For more advanced configuration information, refer to:

- "XStream Advanced Programming & Configuration" manual (for AT Command Mode Options, Diagnostics, Networking, Serial Interfacing and Sleep Modes)
- "XPort User Manual (for advanced configurations specific to the Ethernet port)

Both manuals are located in the "documentation" folder of the MaxStream CD.

AT Command Mode

In order to set or modify RF Modem parameters, the RF Modem must first enter into "AT Command Mode", a state in which incoming characters are interpreted as AT commands instead of data to be transmitted.

Enter AT Command Mode

To enter AT Command Mode, use any of the following methods:

1. Send the 3-character command sequence "+++" with one second of silence before and after the command characters. [See the "Default AT Command Mode Sequence" below.] The "Terminal" tab (or other serial communications software) of the X-CTU Software can be used to enter the sequence.
2. Press-in the Config Switch [Figure 2c] while turning off and then on again the Power Switch [Figure 1a].

Default AT Command Mode Sequence (for entering into AT Command Mode)**:**

1. No characters sent for one second.
   [Time can be modified using BT (Guard Time Before) Command]
2. Input three (3) plus characters ("+++") within one second.
   [Character can be modified using CC (Command Sequence Character) Command.]
3. No characters sent for one second.
   [Time can be modified using the AT (Guard Time After) Command.]

NOTE: Binary Commands do not work with the Ethernet RF Modem because $\overline{\text{RTS}}$ cannot be controlled over Ethernet. Refer to the "Advanced Programming & Configuration" manual for more information.

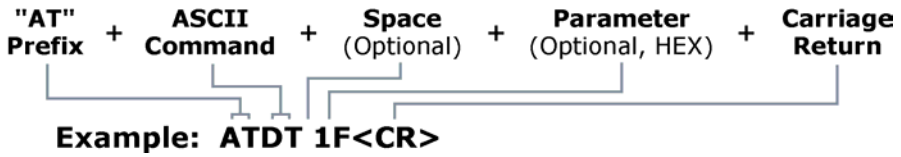
AT Commands

AT Commands can be used to adjust several modem characteristics:

- AT Command Mode Options
- Diagnostics
- Networking
- Serial Interfacing
- Sleep (Low Power)

A terminal program has been built into the X-CTU software and is located under the "Terminal" tab. Use the following syntax when using terminal software to issue AT Commands.

Figure 12. Syntax for sending XStream OEM RF Module AT Commands:



NOTE: To read a parameter value stored in a register, leave the parameter field blank.

The preceding example would change the "Destination Address" of the RF Modem to "1F". To store the new value to the modem's non-volatile (long term) memory, use the WR (Write) Command [ATWR<CR>].

Parameters can be read and modified by sending AT Commands to the RF Modem via MaxStream's X-CTU Software or other serial communications software such as "HyperTerminal". XStream AT Commands are explained in further detail in MaxStream's "XStream Advanced Programming & Configuration" manual.

System Response

Once a command is sent to the RF Modem, the modem will parse and execute the command. Upon successful execution of the command, the RF Modem will return an "OK" message. If the execution of a command results in an error, the remainder of the command will not be executed and the RF Modem will return an "ERROR" message.

Exit AT Command Mode

To exit AT Command Mode:

If no valid AT Commands are received within the time specified by CT (AT Command Mode Timeout) Command, the RF Modem automatically returns to Idle Mode.

[or]

Send ATCN (Exit AT Command Mode) Command.

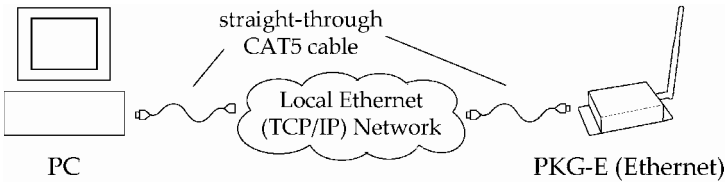
Configuration

MaxStream provides the X-CTU Software for configuring the PKG-E Ethernet RF Modem. Other programs such as "Telnet" can also be used to establish communications.

Local Network Method

1. Install both the X-CTU Software and the Ethernet Com Port Redirector [See "Com Port Communications" [page 7] section for more information].
2. Connect a PC and the Ethernet RF Modem to active Ethernet connections of the same local network [as shown in the figure below].
3. Follow the steps outlined in the "Ethernet RF Modem Discovery" section to be able to identify the com port that will be used to configure the Modem [page 8].
4. Launch the X-CTU Software on the PC and select the "PC Settings" tab.
5. Make sure values shown in the fields of the 'Com Port Setup' section match those of the Ethernet RF Modem.
6. Highlight the Com Port from the 'Select Com Port' list that is mapped to the Ethernet RF Modem.
7. Select the "Terminal" tab. ("Modem Configuration" tab could also be used.)
8. Type three copies of the Command Sequence Character ("+++" by default) to enter into AT Command Mode.
   → System Response: "OK" (Modem enters into AT Command Mode)
9. Type the AT Command "ATHP 5"
   → System Response: "OK" (current hopping channel is changed to '5')
   NOTE: If the RF Modem is to communicate with any other RF Modems, the other RF Modems must also be configured to use the same hopping channel (in this case, 5).
10. Type the AT Command "ATCN"
    → System Response: "OK" (Modem exits from AT Command Mode)
    NOTE: If WR (Write) Command was not used after issuing HP Command, the RF Modem will revert to its previously stored HP value the next time the RF Modem is powered on.

Figure 13. Setup for Local Network Configuration Method



Direct PC Method

The Direct PC method requires use of a crossover CAT5 cable (not the more common straight-through CAT5 cable). To connect an Ethernet RF Modem directly to a PC, follow these steps:

1. Connect a crossover CAT5 cable between the Ethernet RF Modem and the PC.
2. Set up the com port using the instructions outlined in the "Software" and "Setup Com Port" sections of this manual.
3. Use the "Terminal" or "Modem Configuration" tabs of the X-CTU Software to send AT Commands to the RF Modem. (Other terminal software programs can also be used as described in the "Testing Communications" section on page 10.)

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XStream Commands (Short View)

Table 2. XStream AT Commands as of Firmware Version 4.2AB

AT Command	Binary Command	AT Command Name	Range	Command Category	# Bytes Returned	Factory Default
AT	0x05 (5d)	Guard Time After	0x02 – 0xFFFF (x 100 ms)	AT Command Mode Options	2	0x0A (10d)
BD	0x15 (21d)	Baud Rate	0 – 6	Serial Interfacing	1	RF data rate
BT	0x04 (4d)	Guard Time Before	0 – 0xFFFF (x 100 ms)	AT Command Mode Options	2	0x0A (10d)
CC	0x13 (19d)	Command Sequence Character	0x20 – 0x7F	AT Command Mode Options	1	0x2B ("+")
CD v 4.29D*	0x28 (40d)	DO3 Configuration	0 - 3	Serial Interfacing	1	0
CN	0x09 (9d)	Exit AT Command Mode	none	AT Command Mode Options	n/a	none
CS v 4.27D*	0x1F (31d)	DO2 Configuration	0 – 4	Serial Interfacing	1	0
CT	0x06 (6d)	AT Command Mode Timeout	0x02 – 0xFFFF (x 100 ms)	AT Command Mode Options	2	0xC8 (200d)
DT	0x00 (0d)	Destination Address	0 – 0xFFFF	Networking	2	0
E0	0x0A (10d)	Echo Off	none	AT Command Mode Options	n/a	none
E1	0x0B (11d)	Echo On	none	AT Command Mode Options	n/a	none
ER	0x0F (15d)	Receive Error Count.	0 – 0xFFFF	Diagnostic	2	0
FH	0x0D (13d)	Force Wake-up Initializer	none	Sleep (Low Power)	n/a	none
FL	0x07 (7d)	Software Flow Control	0 – 1	Serial Interfacing	1	0
FT v 4.27B*	0x24 (36d)	Flow Control Threshold	0x0 – 0xFF (bytes)	Serial Interfacing	2	varies
GD	0x10 (16d)	Receive Good Count	0 – 0xFFFF	Diagnostic	2	0
HP	0x11 (17d)	Hopping Channel	0 – 6	Networking	1	0
HT	0x03 (3d)	Time before Wake-up Initializer	0 – 0xFFFF (x 100 ms)	Sleep (Low Power)	2	0xFFFF
ID v 4.27C*	0x27 (39d)	Modem VID	0 – 0xFFFF (Read-only)	Networking	2	none
LH	0x0C (12d)	Wake-up Initializer Timer	0 – 0xFF (x 100 ms)	Sleep (Low Power)	1	1
MK	0x12 (18d)	Address Mask	0 – 0xFFFF	Networking	2	0xFFFF
NB v 4.27B*	0x23 (35d)	Parity	0 – 4	Serial Interfacing	1	0
PC v 4.22*	0x1E (30d)	Power-up Mode	0 – 1	AT Command Mode Options	1	0
PW v 4.22*	0x1D (29d)	Pin Wake-up	0 – 1	Sleep (Low Power)	1	0
RE	0x0E (14d)	Restore Defaults	None	(Special)	n/a	none
RN v 4.22*	0x19 (25d)	Delay Slots	0 – 0xFF (slots)	Networking	1	0
RO v 4.2AA*	0x21 (33d)	Time before Transmission	0 – 0xFFFF (x 0.2 ms)	Serial Interfacing	2	0x20 (32d)
RP v 4.2AA*	0x22 (34d)	RSSI PWM Timer	0 - 0x7F (x 100 ms)	Diagnostic	1	0
RR v 4.22*	0x18 (24d)	Retries	0 – 0xFF	Networking	1	0
RS v 4.22*	0x1C (28d)	RSSI	0x06 – 0x36 (Read-only)	Diagnostic	1	none
RT	0x16 (22d)	DI2 Configuration	0 - 2	Serial Interfacing	1	0
SH v 4.27C*	0x25 (37d)	Serial Number High	0 – 0xFFFF (Read-only)	Diagnostic	2	none
SL v 4.27C*	0x26 (38d)	Serial Number Low	0 – 0xFFFF (Read-only)	Diagnostic	2	none
SM	0x01 (1d)	Sleep Mode	0 – 8	Sleep (Low Power)	1	0
ST	0x02 (2d)	Time before Sleep	0x10 – 0xFFFF (x 100 ms)	Sleep (Low Power)	2	0x64 (100d)
SY	0x17 (23d)	Time before Initialization	0 – 0xFF (x 100 ms)	Networking	1	0 (disabled)
TR v 4.22*	0x1B (27d)	Transmit Error Count	0 – 0xFFFF	Diagnostic	2	0
TT v 4.22*	0x1A (26d)	Streaming Limit	0 – 0xFFFF [0 = disabled]	Networking	2	0xFFFF
VR	0x14 (20d)	Firmware Version	0 x 0xFFFF (Read-only)	Diagnostic	2	none
WR	0x08 (8d)	Write	none	(Special)	n/a	none

* Firmware version in which the command was introduced. All subsequent firmware versions also support the command.

MORE INFORMATION: Refer to the "XStream Advanced Programming & Configuration" manual for more detailed information concerning the AT Commands supported by the XStream PKG RF Modem.

Appendix A: Agency Certifications

FCC Compliance

The MaxStream XStream-PKG-E Ethernet RF Modem has been tested and certified to comply with Part 15 of the FCC Rules. In order to inherit MaxStream's FCC Certification, compliance requires the following be stated:

FCC ID: **OUR9XSTREAM** (for 900 MHz) or **OUR-24XSTREAM** (for 2.4 GHz)
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

OEM Labeling Requirements

Label Warning

WARNING The Original Equipment Manufacturer (OEM) must ensure that FCC labeling requirements are met. This includes a clearly visible label on the outside of the final product enclosure that displays the contents shown in the figure below.

Figure 14. Required FCC Label for OEM products containing 9XStream (900 MHz) OEM RF Module

Contains FCC ID: OUR9XSTREAM
The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

Figure 15. Required FCC Label for OEM products containing 24XStream (2.4 GHz) OEM RF Module

Contains FCC ID: OUR-24XSTREAM
The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC Notices

Adherence to the following is required:

IMPORTANT: The 9XStream (900 MHz) and 24XStream (2.4 GHz) OEM Modules have been certified by the FCC for use with other products without any further certification (as per FCC section 2.1091). Changes or modifications not expressly approved by MaxStream could void the user's authority to operate the equipment.

IMPORTANT: OEMs must test their final product to comply with unintentional radiators (FCC section 15.107 and 15.109) before declaring compliance of their final product to Part 15 of the FCC Rules.

IMPORTANT: The XStream-PKG-E Ethernet RF Modems have been certified for remote and base radio applications. If the XStream will be used for portable applications, the device must undergo SAR testing.

NOTE:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Antenna Warning

WARNING: This device has been tested with Reverse Polarity SMA connectors with the antennas listed in Tables 12 & 13 of Appendix A. When integrated in OEM products, fixed antennas require installation preventing end-users from replacing them with non-approved antennas. Antennas not listed in the tables must be tested to comply with FCC Section 15.203 (unique antenna connectors) and Section 15.247 (emissions).

9XStream-PKG-E (900 MHz) Approved Antenna List

Table 3. XStream-PKG-E 900 MHz Approved Antennas with Separation Distances compliant with FCC Exposure Requirements

Manufacturer	900 MHz Part Number	Type	Gain	Application	Minimum Separation Distance
*	*	Yagi	6.2 dBi	Fixed/Mobile **	20 cm
*	*	Yagi	7.2 dBi	Fixed/Mobile **	20 cm
MaxStream	A09-Y8	Yagi	8.2 dBi	Fixed/Mobile **	20 cm
*	*	Yagi	9.2 dBi	Fixed/Mobile **	20 cm
*	*	Yagi	10.2 dBi	Fixed/Mobile **	20 cm
MaxStream	A09-Y11	Yagi	11.2 dBi	Fixed/Mobile **	20 cm
MaxStream	A09-F2	Omni Direct.	2.2 dBi	Fixed **	20 cm
MaxStream	A09-F5	Omni Direct.	5.2 dBi	Fixed **	20 cm
MaxStream	A09-F8	Omni Direct.	8.2 dBi	Fixed **	20 cm
*	*	Omni Direct.	9.2 dBi	Fixed **	20 cm
*	*	Omni Direct.	7.2 dBi	Fixed **	20 cm
MaxStream	A09-M7	Omni Direct.	7.2 dBi	Fixed **	20 cm
MaxStream	A09-H	1/2 wave antenna	2.1 dBi	Fixed/Mobile **	20 cm
MaxStream	A09-HBMM-P5I	1/2 wave antenna	2.1 dBi	Fixed/Mobile **	1cm
MaxStream	A09-QBMM-P5I	1/4 wave antenna	1.9 dBi	Fixed/Mobile **	1cm
*	*	1/4 wave integrated wire antenna	1.9 dBi	Fixed/Mobile **	1cm

* FCC-approved antennas not inventoried by MaxStream – Contact MaxStream (801-765-9885) for information.

** Can be approved for portable applications if integrator gains approval through SAR testing

MaxStream radio modems are pre-FCC approved for use in fixed base station and mobile applications. As long as the antenna is mounted at least 20 cm (8 in) from nearby persons, the application is considered a mobile application. If the antenna will be mounted closer than 20 cm to nearby persons, then the application is considered "portable" and requires an additional test performed on the final product. This test is called the Specific Absorption Rate (SAR) testing and measures the emissions from the radio modem and how they affect the person.

RF Exposure

WARNING: This equipment is approved only for mobile and base station transmitting devices, separation distances of (i) 20 centimeters or more for antennas with gains < 6 dBi or (ii) 2 meters or more for antennas with gains ≥ 6 dBi should be maintained between the antenna of this device and nearby persons during operation. To ensure compliance, operation at distances closer than this is not recommended.

The preceding statement must be included as a CAUTION statement in manuals for OEM products to alert users on FCC RF Exposure compliance.

In order to fulfill the FCC Certification requirements, the OEM must comply with FCC regulations:

1. The system integrator must ensure that the text on the sample label is placed on the outside of the final product [Figure 14].
2. The 9XStream-PKG-E Ethernet RF Modem (900 MHz) may be used only with Approved Antennas that have been tested with this module. [Table 2]

24XStream-PKG-E (2.4 GHz) Approved Antenna List

Table 4. XStream-PKG-E 2.4 GHz Approved Antennas with Separation Distances compliant with FCC Exposure Requirements

Manufacturer	2.4 GHz Part Number	Type	Gain	Application	Minimum Separation Distance
*	*	Yagi	6 dBi	Fixed **	2m
*	*	Yagi	8.8 dBi	Fixed **	2m
*	*	Yagi	9 dBi	Fixed **	2m
*	*	Yagi	10 dBi	Fixed **	2m
*	*	Yagi	11 dBi	Fixed **	2m
*	*	Yagi	12 dBi	Fixed **	2m
*	*	Yagi	12.5 dBi	Fixed **	2m
*	*	Yagi	13.5 dBi	Fixed **	2m
*	*	Yagi	15 dBi	Fixed **	2m
*	*	Omni Direct.	2.1 dBi	Fixed/Mobile **	20 cm
*	*	Omni Direct.	3 dBi	Fixed/Mobile **	20 cm
*	*	Omni Direct.	5 dBi	Fixed/Mobile **	20 cm
*	*	Omni Direct.	7.2 dBi	Fixed **	2m
*	*	Omni Direct.	8 dBi	Fixed **	2m
*	*	Omni Direct.	9.5 dBi	Fixed **	2m
*	*	Omni Direct.	10 dBi	Fixed **	2m
*	*	Omni Direct.	12 dBi	Fixed **	2m
*	*	Omni Direct.	15 dBi	Fixed **	2m
MaxStream	A24-P8	Panel	8.5 dBi	Fixed **	2m
MaxStream	A24-P13	Panel	13 dBi	Fixed **	2m
*	*	Panel	14 dBi	Fixed **	2m
*	*	Panel	15 dBi	Fixed **	2m
*	*	Panel	16 dBi	Fixed **	2m
MaxStream	A24-P19	Panel	19 dBi	Fixed **	2m
MaxStream	A24-HABMM-P6I	Dipole	2.1 dBi	Fixed/Mobile **	20 cm
MaxStream	A24-HBMM-P6I	Dipole	2.1 dBi	Fixed/Mobile **	20 cm
MaxStream	A24-HABSM	Dipole	2.1 dBi	Fixed/Mobile **	20 cm
MaxStream	A24-QABMM-P6I	Monopole	1.9 dBi	Fixed/Mobile **	20 cm
*	A24-Q1	Monopole	1.9 dBi	Fixed/Mobile **	20 cm
*	*	Monopole	1.9 dBi	Fixed/Mobile **	20 cm

* FCC-approved antennas not inventoried by MaxStream – Contact MaxStream (801-765-9885) for information.

** Can be approved for portable applications if integrator gains approval through SAR testing

RF Exposure

WARNING: This equipment is approved only for mobile and base station transmitting devices, separation distances of (i) 20 centimeters or more for antennas with gains < 6 dBi or (ii) 2 meters or more for antennas with gains ≥ 6 dBi should be maintained between the antenna of this device and nearby persons during operation. To ensure compliance, operation at distances closer than this is not recommended.

The preceding statement must be included as a CAUTION statement in manuals for OEM products to alert users on FCC RF Exposure compliance.

In order to fulfill the FCC Certification requirements, the OEM must comply with FCC regulations:

1. The system integrator must ensure that the text on the sample label is placed on the outside of the final product [Figure 15].
2. The 24XStream (2.4 GHz) OEM RF Module may be used only with Approved Antennas that have been tested with this module. [Table 3]

European Compliance (2.4 GHz only)

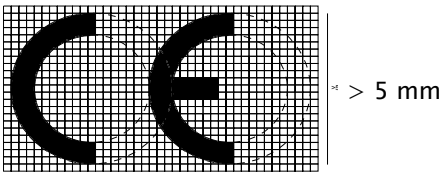
The 24XStream has been certified for several European countries. For a complete list, go to www.maxstream.net.

If the 24XStream modules are incorporated into a product, the manufacturer must ensure compliance of the final product to the European harmonized EMC and low-voltage/safety standards. A Declaration of Conformity must be issued for each of these standards and kept on file as described in Annex II of the R&TTE Directive. Furthermore, the manufacturer must maintain a copy of the XStream user manual documentation and ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in the user manual. Changes or modifications not expressly approved by MaxStream could void the user's authority to operate the equipment.

OEM Labeling Requirements

The 'CE' marking must be affixed to a visible location on the OEM product.

Figure 16. CE Label Requirements



The CE mark shall consist of the initials "CE" taking the following form:

- If the CE marking is reduced or enlarged, the proportions given in the above graduated drawing must be respected.
- The CE marking must have a height of at least 5mm except where this is not possible on account of the nature of the apparatus.
- The CE marking must be affixed visibly, legibly, and indelibly.

Furthermore, since the usage of the 2400 – 2483.5 MHz band is not harmonized throughout Europe, the Restriction sign must be placed to the right of the 'CE' marking as shown below. See the R&TTE Directive, Article 12 and Annex VII for more information

Figure 17. CE Label Required on OEM Equipment

Restrictions

France – France imposes restrictions on the 2.4 GHz band. Go to www.art-Eelecom.Fr or contact MaxStream for more information.

Norway – Norway prohibits operation near Ny-Alesund in Svalbard. More information can be found at the Norway Posts and Telecommunications site (www.npt.no).

24XStream Declarations of Conformity

MaxStream has issued Declarations of Conformity for the 24XStream modules concerning emissions, EMC and safety. These files are located in the 'documentation' folder of the MaxStream CD.

Important Note

MaxStream does not list the entire set of requirements that must be met for each country. MaxStream customers assume full responsibility for learning and meeting the required guidelines for each country in their distribution market. For more information relating to European compliance of an OEM product incorporating the 24XStream module, contact MaxStream, or refer to the following web sites:

CEPT ERC 70-03E – Technical Requirements, European restrictions and general requirements: Available at www.ero.dk/

R&TTE Directive – Equipment requirements, placement on market: Available at www.ero.dk/

Notifications and Required Information

Since the 2.4 GHz band is not harmonized throughout Europe, a notification must be sent to each country prior to shipping product according to Article 6.4 of the R&TTE Directive. A list of national contacts for most European countries may be found at www.ero.dk/.

The following technical data (relating to the 24XStream) is often required in filling out a notification form.

- Frequency Band: 2400 – 2483.5 MHz
- Modulation: Frequency Shift Keying
- Channel Spacing: 400 kHz
- ITU Classification: 400KF1D
- Output Power: 100 mW EIRP
- Notified Body Number: 0891

Contact MaxStream (801) 765-9885 if additional information is required.

Table 5. Antennas approved for use with 24XStream (2.4 GHz) Ethernet RF Modems in Europe

Manufacturer	Part Number	Type	Gain	Application	Minimum Separation Distance
MaxStream	A24-HABMM-P6I	Dipole	2.1 dBi	Fixed/Mobile	20 cm
MaxStream	A24-HBMM-P6I	Dipole	2.1 dBi	Fixed/Mobile	20 cm
MaxStream	A24-HABSM	Dipole	2.1 dBi	Fixed/Mobile	20 cm
MaxStream	A24-QABMM-P6I	Monopole	1.9 dBi	Fixed/Mobile	20 cm
MaxStream	A24-QBMM-P6I	Monopole	1.9 dBi	Fixed/Mobile	20 cm
MaxStream	A24-Q1	Monopole	1.9 dBi	Fixed/Mobile	20 cm

IC (Industry Canada) Certification

Labeling requirements for Industry Canada are similar to those of the FCC. A clearly visible label on the outside of the final product enclosure must display the following text:

Contains Model 9XStream Radio (900 MHz), IC: 4214A-9XSTREAM
Contains Model 24XStream Radio (2.4 GHz), IC: 4214A 12008

Integrator is responsible for its product to comply with IC ICES-003 & FCC Part 15, Sub. B - Unintentional Radiators. ICES-003 is the same as FCC Part 15 Sub. B and Industry Canada accepts FCC test report or CISPR 22 test report for compliance with ICES-003.

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Appendix B: Additional Information

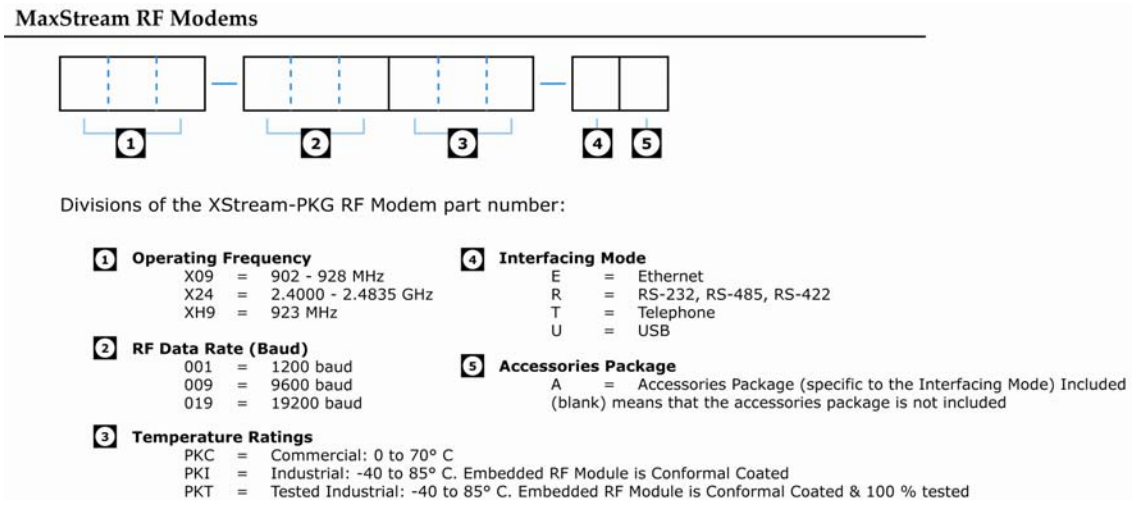
1-Year Warranty

The XStream-PKG-E Ethernet RF Modem from MaxStream, Inc. (the "Product") is warranted against defects in materials and workmanship under normal use, for a period of 1-year from the date of purchase. In the event of a product failure due to materials or workmanship, MaxStream will repair or replace the defective product. For warranty service, return the defective product to MaxStream, shipping prepaid, for prompt repair or replacement.

The foregoing sets forth the full extent of MaxStream's warranties regarding the Product. Repair or replacement at MaxStream's option is the exclusive remedy. THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, AND MAXSTREAM SPECIFICALLY DISCLAIMS ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL MAXSTREAM, ITS SUPPLIERS OR LICENSORS BE LIABLE FOR DAMAGES IN EXCESS OF THE PURCHASE PRICE OF THE PRODUCT, FOR ANY LOSS OF USE, LOSS OF TIME, INCONVENIENCE, COMMERCIAL LOSS, LOST PROFITS OR SAVINGS, OR OTHER INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT, TO THE FULL EXTENT SUCH MAY BE DISCLAIMED BY LAW. SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES. THEREFOR, THE FOREGOING EXCLUSIONS MAY NOT APPLY IN ALL CASES. This warranty provides specific legal rights. Other rights which vary from state to state may also apply.

XStream-PKG RF Modem Part Numbers

Figure 18. XStream-PKG RF Modem Part Number Key


MaxStream RF Modems
1
2
3
4
5
Divisions of the XStream-PKG RF Modem part number:
1 Operating Frequency
X09 = 902 - 928 MHz
X24 = 2.4000 - 2.4835 GHz
XH9 = 923 MHz
2 RF Data Rate (Baud)
001 = 1200 baud
009 = 9600 baud
019 = 19200 baud
3 Temperature Ratings
PKC = Commercial: 0 to 70° C
PKI = Industrial: -40 to 85° C. Embedded RF Module is Conformal Coated
PKT = Tested Industrial: -40 to 85° C. Embedded RF Module is Conformal Coated & 100 % tested
4 Interfacing Mode
E = Ethernet
R = RS-232, RS-485, RS-422
T = Telephone
U = USB
5 Accessories Package
A = Accessories Package (specific to the Interfacing Mode) Included
(blank) means that the accessories package is not included

For Example: X09-009PKC-EA

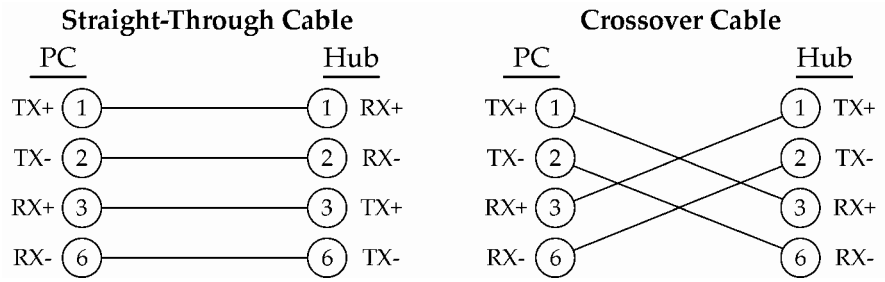
XStream Product Family, 900 MHz, 9600 Baud, Commercial Temperature Rating, Ethernet Interface, w/ Ethernet Accessories Package

Ethernet Background Information

Ethernet Port (RJ-45) Pin Signals

The MaxStream Ethernet RF Modem uses standard Ethernet protocol.

Figure 19. Ethernet Pinout Diagrams



Networking Terms

DHCP: Dynamic Host Configuration Protocol - A protocol for automated assigning of dynamic IP addresses to devices on a network. DHCP allows IP addresses to be pooled and assigned as needed to clients.

Auto IP: If the XStream-PKG-E Ethernet RF Modem sits on a network that does not include a DHCP server, the built-in "Auto IP" feature will enable the modem to assign itself an IP address. The Intelligent XPort Ethernet Port will communicate with the server and determine what IP addresses are available. The Ethernet RF Modem will then assign itself the first available IP address it finds.

IP (Logical) Address: A logical address used in TCP/IP networking. This unique 32-bit number is divided into four groups of octets (8-bit bytes) that are separated by periods.

Hardware (Physical or MAC) Address: Number that uniquely identifies a network node. The hardware address is hard-coded to the device at the factory by the manufacturer. The hardware address is printed on the Ethernet port inside the XStream-PKG-R RF Modem.

Subnet: A portion of a network that shares a network address with other portions of a network and is distinguished by a subnet number. Subnets are formed when an IP network is broken down into smaller networks using a subnet mask.

Subnet Mask: A "filter" that tells the server whether a node is on the local network or a remote network. If the server IP address and the remote IP address appear the same after the filter, the remote host is assumed to be on the same local network. Otherwise, the gateway is used. When combined with an IP address, the subnet mask informs the rest of the network as to what kind of subnet the device is on.

Contact MaxStream

Free and unlimited technical support is included with every MaxStream Radio Modem sold.

Documentation: www.maxstream.net/helpdesk/

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